PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(19)

(54) FLOW CONTROL VALVE DEVICE

(71) We, THE BRITISH OXYGEN COMPANY LIMITED, of Hammersmith House, London, W.6, England, a British company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to flow control or "cylinder" valves, by which is meant valves intended to control the flow of gas from a cylinder or other container in which the gas is stored under pressure.

Known cylinder valves include a minimum-pressure valve which is effective to stop the flow of gas from the cylinder (even when the main shut-off valve is open) when the pressure of the gas in the cylinder falls to a specified value which is still above atmospheric. This is in order to prevent atmospheric or other gases from flowing into the interior of the cylinder, so that the cylinder may be recharged from a source of fresh gas without the cylinder having first to be purged of any contaminating or adulterating gases.

In known cylinder valves some components have to be manipulated or at least partially dismantled before the cylinder can be recharged. The present invention aims at overcoming this disadvantage by providing a cylinder valve by which a cylinder can be recharged solely by connecting to the valve a source of fresh gas at a sufficiently-high pressure.

According to the present invention there is provided a control valve which is as claimed in the appended claims.

The present invention will now be described by way of example with reference to the accompanying drawings, in which:—

Figure 1 is a view, part in section and part in elevation, of one form of valve of the present invention, and

Figure 2 is a view, similar to Figure 1 but displaced by 90°, of a second form of valve of the present invention.

The valve shown in Figure 1 has a body 2 housing a main shuft-off valve (indicated generally by the reference 4) and a minimum-pressure valve 6. The body 2 has in it a passageway 8 which is intended to be placed in communication with the interior of the cylinder (not shown) when the screw-threaded end 10 of the body is screwed into a tapped recess in the cylinder.

Projecting externally from the valve body is an indicator button 12 integral with a plunger 14 slidable in a cylindrical chamber 16 in communication with the passageway 8. Preventing the plunger 14 from being blown out of the chamber 16 by the pressure of gas in passageway 8 is a screw-threaded cap 18, the cap having in it an annulus 20 of resilient material which is adapted to form a fluid-tight seal with the plunger when the plunger is in the illustrated outer position. The plunger has an O-ring seal 22 to prevent the escape of gas from the passageway 8 to the atmosphere at all positions of the plunger.

The plunger is adapted to operate as a residual-pressure indicator as follows: the button 12 enables the plunger 14 to be pushed into the interior of the chamber 16 so that a negligible part of the button is visible externally of the cap 18. The pressure of the gas in the passageway 8 tends to move the plunger outwardly towards the position shown in Figure 1, but this movement is resisted by friction. When the pressure of gas in the passageway 8 is below a minimum value, then this friction is greater than the gas pressure on the plunger, so that the plunger, and therefore the indicator, stay in position when manual pressure is removed from the button 12. However, when the gas pressure is above this minimum, then it is able to overcome the friction and move the plunger to the illustrated outer position to indicate that the gas pressure is above the minimum.

The extension 23 of the passageway 8 ends in an annular valve seat 24 which cooperates with the head 26 of the minimum-pressure valve 6, the head 26

[*Price 25p*]

carrying a resilient seal 28. The head 26 carries an O-ring seal 30, so that at all positions of the head 26 gas is prevented from leaking from the passageway extension 23 or the interior of the valve body 2 through the screw-threaded connection between the body 2 and the support 32 of the minimum-pressure valve. The head 26 is biased towards the seat 24 by a compression spring 34 encircling a cylindrical extension 36 of the head 26.

On the downstream side of the minimum-pressure valve is a space 38 which communicates with the interior of the head 40 of the main shut-off valve 4. The head is biased upwardly as viewed, by means of a compression spring 42, and the space in the head is in communication with a central chamber 44 in the valve body through radial passages 46. Positioned in the chamber 44 is an annular fixed valve seat 48 of which the head 50 is held against a shoulder 52 in the valve body by a locking member 54. The valve seat proper of member 48 is provided by an annular rib 56 which is aligned axially with an annular seal 58 carried by head 40. The valve seat is sealed to the walls of chamber 44 by an O-ring 60.

Formed in the seat 48 are radial passages 62 which are in communication with an annular chamber 64 through a filter element 66. By means which are not shown, the chamber 64 is in communication with the outlet of the control valve, the gas-flow passages being shown more clearly in Figure 2.

Extending from the head 40 is an integral shaft 68 which is a sliding fit in the head 50 of the valve seat member. The upper end (as viewed) of the shaft 68 is intended to abut a plunger 70 controlling operation of the control valve.

The control valve shown in Figure 1 is key-operated, by which is meant that it is moved between its opened ad closed positions by rotation of a removable key (not shown), rotation of which is effective to alter the axial position of the plunger 70.

The control valve is shown in Figure 1 in its fully-open position. In this position the plunger 70 forces the valve head 40 away from the seat 56, thus placing chamber 64 (and hence the outlet of the control valve) in fluid communication with space 38. When the cylinder to which the control valve is connected is fully charged, then the pressure of the gas in the passageway 23 is sufficient to force the valve head 26 off its seat against the bias of spring 34. Thus the passageway 8 is in communication with the space 38, and hence with the outlet, so that gas under pressure in the cylinder is able to flow to the outlet at a speed which is dictated primarily by the gap between the seat 56 and the seal 58 on head 40.

Opening into the chamber 44 is a space 72 which is intended to house a bursting disc (not shown). In normal operation the gas flow is as described above, but should an excess pressure develop in chamber 44 then the bursting disc bursts to exhaust most of the contents of the cylinder to atmosphere.

When either the bursting disc has burst or the contents of the cylinder have been exhausted normally, the pressure of gas in the cylinder falls to such a value that the spring 34 is able to overcome the pressure of the gas so that the minimum-pressure valve closes irrespective of the position of the shut-off valve. This prevents the contents of the cylinder from being contaminated by the entry of atmospheric or other gases before the cylinder is recharged.

If for any reason, such as malfunctioning of the minimum-pressure valve, the pressure in the cylinder falls to too low a value, then this may be revealed by pressing in the plunger 14. When the pressure is excessively low, it is not able to restore the plunger to its usual outermost position, against the frictional forces involved. The position of the plunger after release of the manual force, is interpreted accordingly. Effectively this gives a visual indication of the state of the minimum-pressure valve.

Turning now to Figure 2 of the accompanying drawings, the principal difference between this control valve and that shown in Figure 1 is that the Figure 2 variant is intended to be operated by a handwheel 80, and not by a key. Rotation of the handwheel is effective, by means which are not shown in great detail, to alter the axial position of the plunger 70.

In Figure 2, parts identical with the valve of Figure 1 have been given the same references.

It will be seen from Figure 2 that the chamber 64 is in communication with the outlet 82 of the control valve through an inclined passage 84, all gas passing from the cylinder to the outlet, or *vice versa*, being forced to pass through the filter 66 to remove extraneous bodies.

The valve is shown in Figure 2 in its fully-closed position in which the plunger 70 is spaced from the end of the shaft 68 to allow the gas pressure in the cylinder, assisted by spring 42, to push the head 40 of the shut-off valve into engagement with its valve seat 48.

Let it be assumed that the cylinder to which the control valve is connected is exhausted, so that the minimum-pressure valve 6 stays closed irrespective of the position of the shut-off valve 4. In accordance with the invention, all that it is necessary to do to recharge the cylinder is to connect to the outlet 82 a source of fresh gas at a sufficiently high pressure. This of course reverses the usual direction of gas flow, but

for consistency the same terminology has been retained.

The fresh gas flows in through passageway 84, chamber 64, and filter 66 to the interior of the valve seat 48. The pressure on the annular surface of seal 58 immediately surrounding the shaft 68 is sufficiently high for the valve head to be moved away from the valve seat to permit the fresh gas to flow into the chamber 44. From here the gas passes to the space 38. Again the gas pressure acting on the annular end faces of the head 26 of the minimum-pressure valve is sufficient to force the valve head away from the seat 24 to permit gas to pass into the passageway 8 and from there to the interior of the cylinder. Thus it will be seen that the cylinder has been recharged without any manipulation of any components of the control valve except such as is necessary to connect the source to the outlet 82. This makes the recharging of cylinders considerably more convenient and quicker than known methods, and, as it does not involve any dismantling of the control valve, the introduction of foreign matter into the interior of the control valve is largely eliminated.

Although it has not been illustrated in the drawings, the housing 2 of the control valve may be provided with a contents indicator in the form of a spring-biased plunger. The plunger is exposed to the gas pressure in the chamber 44 and adopts a position in which the gas pressure on the plunger is balanced by the spring pressure, so giving an effective indication of the available gas pressure.

When the cylinder is to be completely evacuated, such as before it is first filled with a specified gas, the most convenient way to do this is to remove the residual-pressure indicator 14 and attach a conduit connected to a vacuum pump.

During the evacuation process the state of the minimum-pressure valve can be tested simply by opening the shut-off valve. If this has no effect, it shows that the minimum-pressure valve is seated correctly. However, the continued flow of air into the cylinder, making evacuation impossible, shows that the minimum-pressure valve is faulty.

WHAT WE CLAIM IS:—

1. A flow control valve device for a cylinder or other container of gas under pressure, in which a valve body houses a shut-off valve and a minimum-pressure valve positioned in series between an outlet of the valve device and a passage intended to communicate with the cylinder interior, in which both the shut-off and minimum-pressure valves have movable heads which are designed to be lifted off corresponding seats solely by the application to the said outlet of a source of gas at a relatively-high pressure to enable gas to flow from the source into the cylinder.

2. A flow control valve device as claimed in claim 1, in which gas flowing from the cylinder passes through the minimum-pressure valve before passing through the shut-off valve.

3. A flow control valve device as claimed in claim 1 or 2, in which the minimum-pressure valve includes a head spring-biassed towards a frusto-conical seat in which is a passage leading towards the interior of the cylinder, the cross-sectional area of the said passage being less than that of the head.

4. A flow control device as claimed in claim 3, in which the said head has projecting from it a stem which is in sliding contact with a support member secured to the body of the control valve device, the end of the stem remote from the head being housed within the support member at all axial positions of the head.

5. A flow control valve device as claimed in any preceding claim, in which the shut-off valve includes a hollow head spring-biassed towards a fixed, annular valve seat, in which the interior of the head is in communication with the interior of the chamber in which the head moves, and in which the head has projecting from it a stem which passes through and beyond the valve seat to abut an axially-movable operating member.

6. A flow control valve device as claimed in claim 5, in which the projecting end of the stem of the shut-off valve head is a sliding fit in a support member integral with the valve seat.

7. A flow control valve as device claimed in claim 5 or 6, in which downstream of the shut-off valve seat is an annular chamber in which is positioned a filter for dust or other foreign matter, the outlet of the valve device being in communication with the downstream side of the filter.

8. A flow control valve device as claimed in any preceding claim, in which in communication with the upstream side of the serially-arranged valves is a cylindrical chamber sealed from the atmosphere, the chamber having in it a plunger which is able to move against a restricting force from an inner position to an outer position only when the pressure of the gas in the interior of the cylinder is at or above a desired minimum, the plunger being movable manually to its inner position and carrying an indicator visible externally of the body only when it is spaced from its inner position.

9. A flow control valve device as claimed in claim 8, in which the indicator takes the form of a projection from the plunger, the projection passing through a cap which is

secured to the valve body and which limits the outward movement of the plunger, the outer end of the projection lying within, or extending by a negligible amount from the outer face of, the cap when the plunger is in its innermost position.

10. A flow control valve device as claimed in claim 8 or 9, in which the restricting force on the plunger is due to friction and is provided by an O-ring seated in the plunger and in frictional sliding contact with the valve body.

11. A flow control valve device for a cylinder or other container of gas under pressure, substantially as described herein with reference to, and as shown in, Figure 1 or Figure 2 of the accompanying drawings.

For the Applicants,
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Chartered Patent Agent.

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Sheet 1

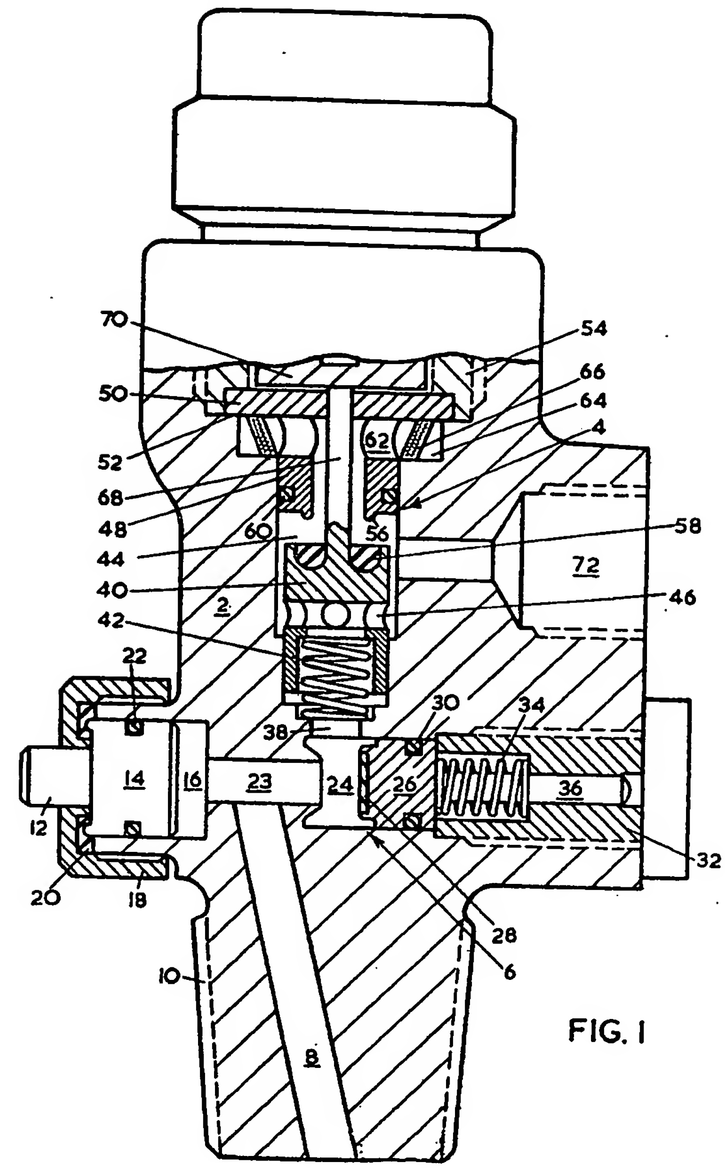

FIG. 1

1319764 COMPLETE SPECIFICATION

2 SHEETS rawing is a reproduction of Original on a reduced scale

Sheet 2

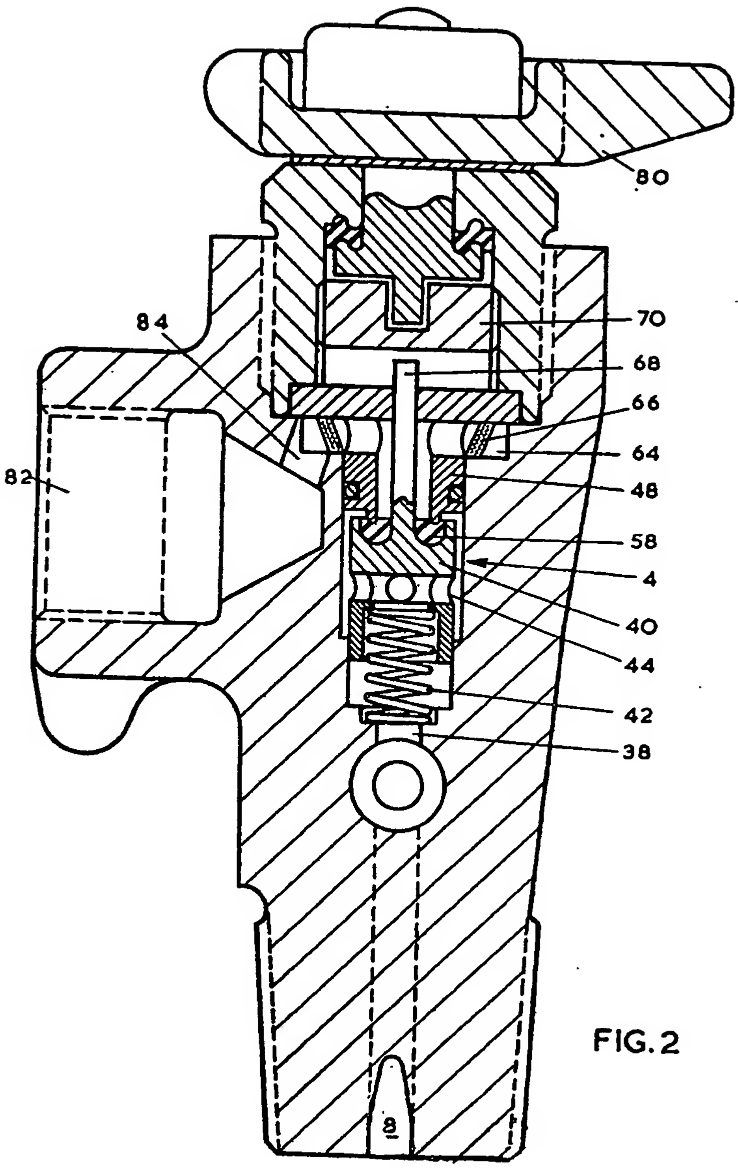

FIG. 2